ARITHMETIC.

Conducted by B. F. FINKEL, Kidder, Missouri. All Contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

22. Proposed by E. S. LOOMIS, A. M., Ph. D., Professor of Mathematics, Baldwin University, Berea, Ohio.

A borrows $1,000 from B for 10 years, on which he pays 4% semi-annually.

A immediately loans the $1,000 to C for 10 years, who agrees to pay to A $12½ on the first of each month for 120 mos. or 10 yrs., at which time the whole debt is considered canceled, C no longer being, in any way, indebted to A. Upon the receipt of each of the $12½ payments made by C, A immediately reloans it to D, E, F, etc., upon the same conditions as he loaned the $1,000 to C; at the end of 120 mos. all who are indebted to A pay up in full all due him, and he (A) pays B the principal, all interest having been paid when due.

Query: How many dollars has he in hand?

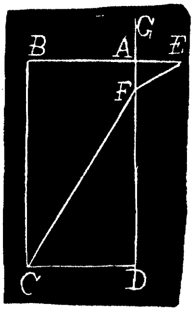
NO SOLUTION RECEIVED.

23. Proposed by H. C. WHITAKER, Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

A rectangular hall 80 feet long, 40 feet wide and 12 feet high, has a spider in one corner of the ceiling. How long will it take the spider to crawl to the opposite corner on the floor, if he crawls a foot in a second on the wall and two feet in a second on the floor?

I. Solution by Professor J. A. TIMMONS, St. Mary's, Kentucky, and the PROPOSER

It seems to me this problem does not belong to arithmetic. Were the *shortest route* required, arithmetic would solve it; a line from E (the *side* wall supposed to be lying down) to C being the required distance=95.41 ft. The time to travel *this* route$=22.02+\frac{73.4}{2}=58.72$ seconds.



Were the spider to descend the *end* wall, a line from G to C would give the shortest distance by that route; but although this distance is *longer* than the other one, being 100.32 ft., the *time* would be shorter, being only $13.085+\frac{87.233}{2}=56.691$ seconds. Hence we see that arithmetic alone will not solve it.

Let F be point when spider reaches the floor; call AF x; then $FD=80-x$.

We have $EF=\sqrt{x^2+144}$, and $CF=\sqrt{8000-160x+x^2}$; hence the *time* required in seconds$=\sqrt{x^2+144}+\sqrt{2000-40x+\frac{x^2}{4}}$; that is, $u=\sqrt{x^2+144}$

$+\sqrt{\frac{x^2}{4}-40x+2000}$, is to be a minimum. $\frac{du}{dx}=\frac{x}{\surd(x^2+144)}+\frac{\frac{x}{4}-20}{\sqrt{\frac{x^2}{4}(40x+2000)}}$.

Making this equal to zero and reducing, we get $3x^4-480x^3+25456x^2+23040-921600=0$. By Horner's Method I find $x=5.88$ ft., nearly, $=AF$, $EF=13.36316$=distance down wall, $FC=84.22454$ ft.=distance on floor.

$\therefore$ Time$=13.36316+84.2254\div2=55.47543$ seconds, *Ans.*

II Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

The spider may take several routes; but the one requiring the *minimum* of time necessitates a perpendicular descent of 12 feet on the wall and a diagonal crossing of $\surd[(80)^2+(40)^2]=89.44+$feet on the floor, and the time required is 56.72 seconds.

III. Solution by J. K ELLWOOD, A. M., Principal of Colfax School, Pittsburg, Pennsylvania; W. L. HARVEY, Portland, Maine; P. S. BERG. Apple Creek. Ohio; COOPER D. SCHMITT, Professor of Mathematics, University of Tennessee, Knoxville, Tennessee: and LINNAEUS HINES, Teacher in High School, Evansville, Indiana.

The entire distance the spider crawls is the hypotenuse of a rt. triangle whose base is 80 ft. and whose perpendicular is 40+12, or 52 ft., which is $\sqrt{80^2+52^2}$, or 95.41+ft.

The height: the width :: 3:10 :: distance crawled on wall : distance on floor. Hence $\frac{3}{13}$ of 95.41+ft., or 22.01 ft. is the distance crawled on wall; and $\frac{10}{13}$ of 95.41+ft., or 73.39ft. is distance crawled on floor.

$\therefore$ $22.01\div1+73.39\div2=58.71+$seconds the time required.

This Problem was also solved by Professor *G. B. M. ZERR, FRANK HORN, M. A. GRUBER,* and *J. H. DRUMMOND.*

24. Proposed by Mrs. MARY E. HOGSETT, Danville, Kentucky.

On January 4. 1889, it was noticed that a clock was 15 minutes fast. On March 1, 1894, it was found to be six and one half minutes slow. When and what time was accurate time?

Solution by FRANK HORN, Meadville, Missouri.

II.
1. 1882 days=time from January 4, 1889 to March 1, 1894.
2. 15 minutes+$6\frac{1}{2}$ minutes=time the clock lost in 1882 days.
3. $\frac{1882}{21\frac{1}{2}}$ days=time required for the clock to lose 1 minute.
4. $1313\frac{1}{43}$ days=time required for the clock to lose 15 minutes.
5. January 4, 1889+$1313\frac{1}{43}$ days=33 minutes $29\frac{1}{4}\frac{3}{3}$ seconds past 12 o'clock, A.M., August 11, 1892.

III. $\therefore$ The clock indicated true time, 33 minutes $29\frac{1}{4}\frac{3}{3}$ seconds past 12 o'clock A. M., provided the observation was made at midnight, January 4, 1889.

This problem was also solved by *J. K. ELLWOOD, H. C. WHITAKER, COOPER D. SCHMITT, G. B. M. ZERR, F. P. MATZ,* and *P. S. BERG.*